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## 114 THE RECIPROCATING STEAM-ENGINE

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down in the sump,

that of the other. The mixture of oil and water settles

and the oil slowly separates and floats to the top, whence it escapes by the higher pipe and is led into the bedplate to be used over again. The water escapes by the other pipe, and is led away outside the engine.

**Cylinders and Distance Pieces.**—In the case of triple-expansion engines, the cylinders are usually separate castings, but some of the smaller compound two-cylinder engines, say up to 200 kw., often have the cylinders cast in one piece.

Sometimes a liner is fitted to the high-pressure cylinder. This is not usual, but with modern high pressures and temperatures it is advisable. Much damage may be done by scoring, due to the temporary failure of lubrication or the use of a poor quality of cylinder oil. In such cases a liner is a great convenience. It is also convenient from the point of view of design, as it enables various conditions of initial steam pressure to be

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most formulae

met, without the main pattern requiring much  
There are  
no very definite rules for the thickness of steam cylinders,

\* being of the empirical type. Usually the barrel stresses are kept low and an allowance made for reboring, but the possibility of inequality in the  
\* thickness of the casting and other considerations are also taken into account.

The barrel stresses due to the steam pressure should not exceed 2400 lb. per square inch for high-pressure cylinders. For intermediate and low-pressure cylinders the stresses may be 2000 lb. and 1000 lb. per square inch respectively. The steam pressures assumed for these calculations are boiler pressures from 180 to 210 lb. per square inch for high-pressure cylinders, 100 to 120 lb. per square inch for intermediate-pressure cylinders, and 30 to 40 lb. for low-pressure cylinders. For compound engines the boiler pressure should be taken for high-pressure cylinders. This is usually lower than in the case of triple-expansion engines, so that the pressure for the low-pressure cylinders of compound engines may be taken as about the same as for triple-expansion engines. In each case an allowance should be made for reboring, say J to f in. according to size, but many high-speed engines have worked for very long periods without

requiring this operation.

The design of the cylinder should be kept as simple as possible, flat surfaces in belts and passages being avoided. Bosses for drain cocks and relief valves should not be larger than necessary, in order to avoid local sponginess in the casting. All flanges and branches should be joined to the main body by generous fillets. The cylinder or liner should be counter-bored, finishing with a taper at the level of the lower edge of the top port to facilitate the introduction of the complete piston into the cylinder and to allow the upper piston rings to overtravel the edge of the counter-bore.

Sometimes a groove is made in the cylinder wall near the bottom to allow the lower edge of the bottom piston ring to overtravel in the same way.

The bottom cover is usually incorporated with the distance piece which connects the cylinder and the crank-case, so that the cylinder itself is a plain casting. Some makers cast the distance piece with the cylinder, but this is to a very great extent a question of manufacture depending upon the